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ABSTRACT

This study investigates and compares American and Chinese secondary students' science achievement, their attitudes toward science, and other factors influencing science learning. The subjects, in Grades 7-12, include Chinese students (N=495) and American students (N=469). A survey of attitudes towards science developed by the authors was employed and the data used to analyze student achievement and attitudes toward science. The discussion of results centers on comparison of student attitudes toward science by country, grade level, and gender. Findings suggest that a student's nationality has a much greater effect on science attitudes than gender or grade level. (DDR)

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Student Attitudes Toward Science Learning: A Cross-National Study of American and Chinese Secondary School Students

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The Purpose of the Study

The purpose of this study is to investigate and compare American and Chinese secondary student science achievement, their attitudes toward science, and other factors influencing science learning. The findings of the study will provide information useful to science educators and teachers for the improvement of science education. This examination of the Chinese and American student science learning experience, may provide helpful insights for both educational systems.

Theoretical Framework

Teaching Standard A of the , *National Science Education Standards*, is "Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students" (National Research Council, 1996). Such requirements rely heavily on a teacher's knowledge of students' cognitive potential, developmental level, physical attributes, affective development, and motivation-- and how they learn.

In "Research on the Affective Dimension of Science Learning" *Handbook of Research on Science Teaching and Learning*, some science educators asked the questions: Why do some graduates become intelligent consumers of science and some do not? Why do some people immerse themselves in science while others shun the scientific enterprise? Why do some students seem to "click" into place while others wander outside the mainstream of science? Answers to these questions are important to science educators. Also, these questions have become increasingly important to researchers in psychology, sociology, and education. Furthermore, these are questions whose solutions

may help us solve some of the tough problems the United States now faces within the education enterprise (Gabel, 1994).

Student behavior is influenced by the values they hold, the motivation they possess, the beliefs they bring from home to the classroom, and the myriad attitudes they have formulated about school, science, and life in general. The key to success in education often depends on how a student feels toward home, self, and school (Simpson, Koballa, Oliver, and Crawley, 1994).

The Chinese science educational experience will provide much information and evidence for world science education study. An ideal model for science education might be:

- Chinese syllabus, American textbook,
- Chinese teachers' systematic lectures plus American teachers' demonstrations and experiments,
- Chinese students' hard-working spirit plus American students' initiative and creativity (Su et al, 1994).

Research Methods

Subjects: Total 964 secondary students (both countries include grade 7 to grade 12) were selected by cluster sampling method from US and China. The sample includes 495 Chinese students (301 females and 194 males), and 469 American students (261 females, 204 males, and 4 students did not report their genders).

Instrument: A survey, "Science Study Attitudes", was developed by the authors based on references of related questionnaires and studies in both countries. The 25 items

were classified into 8 factors. The Likert method was used to score from strongly agree (1) to strongly disagree (5). The Chinese version of the survey was translated by the authors. The data were collected in April to June, 1997.

Data analysis: The description was used to analyze the general trends of secondary school student science learning in both countries; A three-way MANOVA was used to compare different countries, genders, and grade levels. The Tukey multiple comparison was used when the MANOVA showed significant differences in the variables. Multiple linear regressions were used to analyze student achievement and attitudes toward science learning in both countries.

Survey reliability

For whole sample (two countries)
Cronbach alpha = .874;

For the US sample,
Cronbach alpha = .905;

For the Chinese sample,
Cronbach alpha = .830.

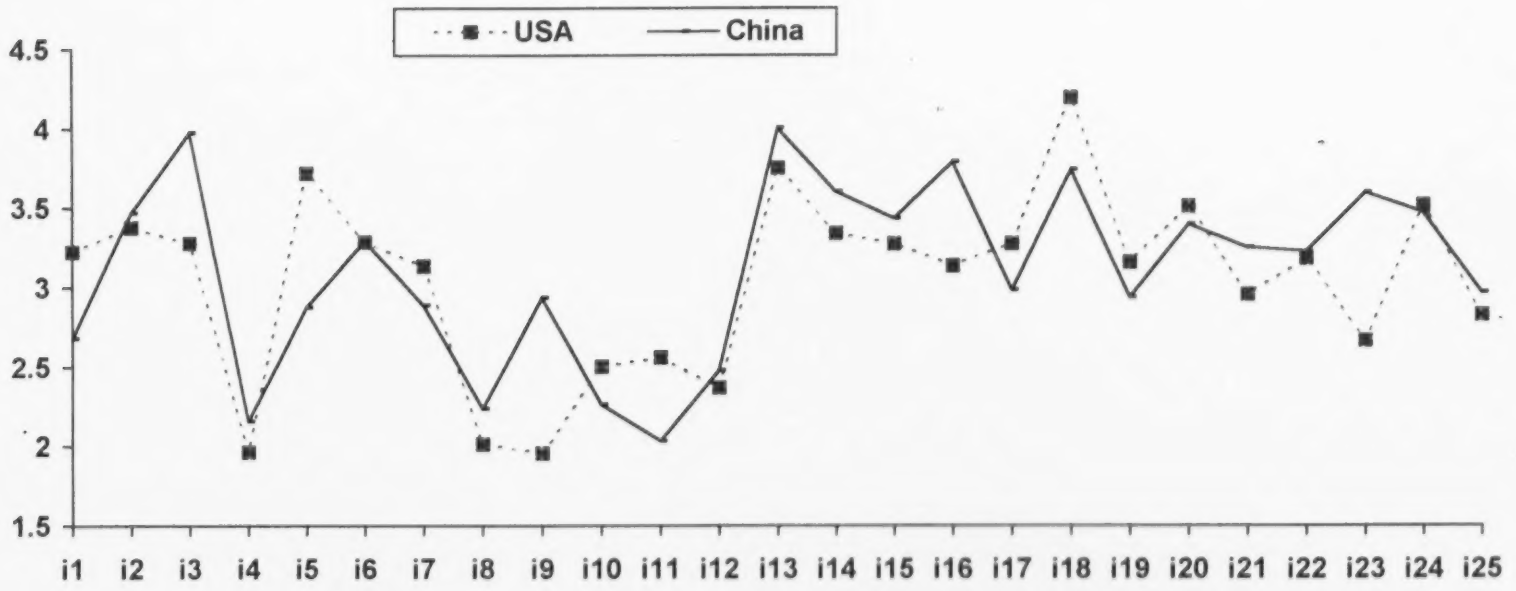

Figure 1. Comparison of Student Attitudes by Country

Significant Differences:
China > USA: 3, 4, 8, 9, 13, 14, 15, 16, 21, & 23;
USA > China: 1, 5, 7, 10, 11, 17, 18, & 19.

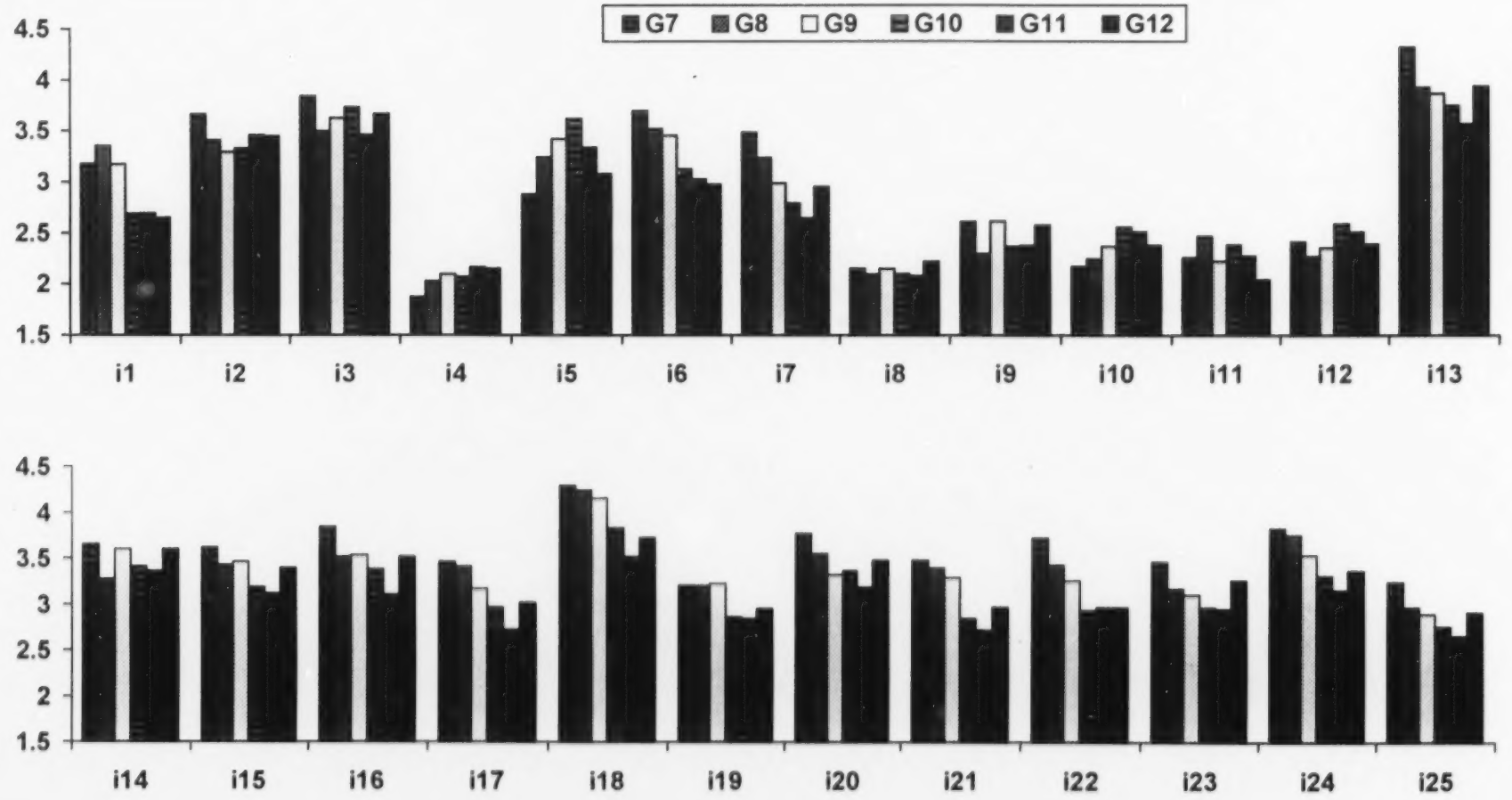

Figure 2. Comparison of Student Attitudes by Grade Level
No significant differences:
4, 8, & 12.

8

9

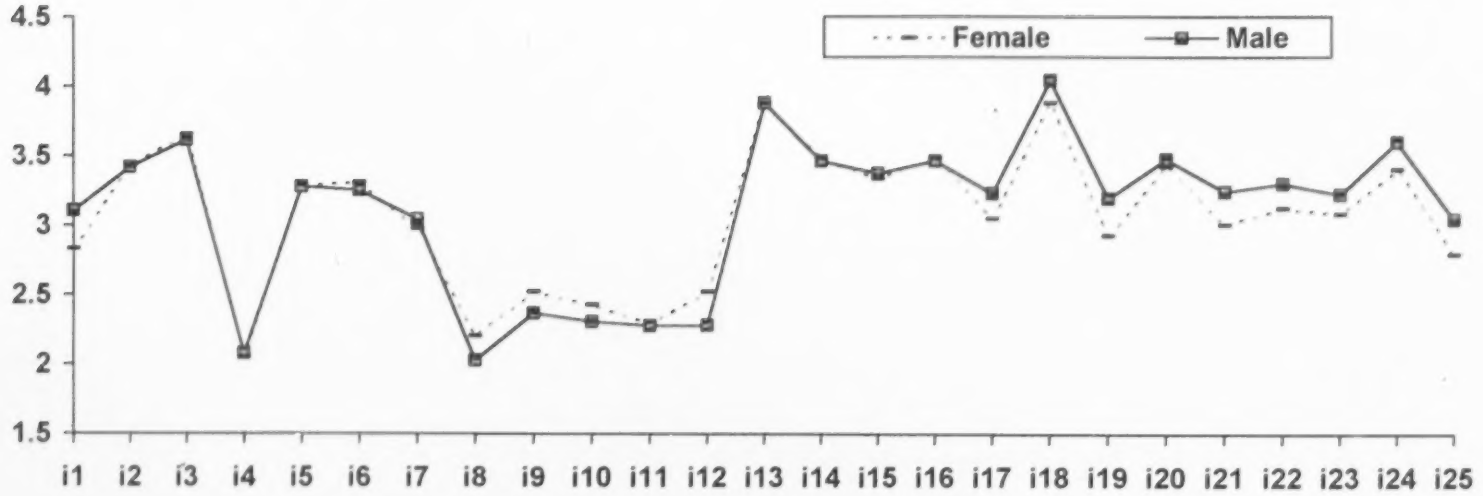

Figure 3. Comparison of Student Attitudes by Gender

Significant differences:
Female > Male: 8, 9, & 12;
Male > Female: 1, 17, 18, 19, 21, 22, 24, & 25.

10

11

Achievement Models:

US: A = 0.424C - 0.150S + 0.147U + 1.876.
(R^2=.299, F=64.89, p=.0001);
China: A = 0.518C - 0.278S - 0.087F + 2.845.
(R^2=.381, F=100.88, p=.0001).

Attitude Models:

US: T = 0.326U + 0.127O + 0.203A + 0.086Sc + 0.094F +0.236
(R^2=.678, F=191.08, p=.0001);
China: T = 0.367A + 0.360O + 0.124U + 0.073Sc +0.138
(R^2=.592, F=177.92, p=.0001).

(A: Achievement, S: School, U: Useful, F: Family, T: Attitude, O: Out school activities, Sc: Scientists.)

Discussion

1. Comparison of student attitudes toward science by country:

US students tend to: consider science study to be easy, take science courses because they are required, are encouraged by scientists' achievements, dislike science because mathematics in science is very difficult and there is too much memorization, like doing science experiments, science courses are favorite classes, and plan to take more science courses.

Chinese students tend to: be encouraged by schools to study science well, be influenced by friends, brothers or sisters, consider science knowledge will be very useful for a future job, higher education, and daily lives, feel honored to have much knowledge of modern science, are interested in physics, and like reading science books and news.

2. Comparison of student attitudes toward science by grade level:

Direct grade level trends were not established. Although most variables were significantly different, none were directly increasing or decreasing with the grade level.

3. Comparison of student attitudes toward science by gender:

Gender differences were not very significant. Male students have slightly higher attitudes toward science.

4. Additional discussion:

A student's nationality has a much greater effect on science attitudes than gender or grade level. Chinese students are more influenced by their families and school administrators than the more independent American students. American students have a more immediate concern of liking science, particularly the lab activities, and less concern for the future than the Chinese students who are more concerned with the usefulness of science in their careers and daily lives.

Perhaps American teachers and administrators should make a greater effort to show their students the relevance and applicability of science, and the importance of science in their futures. Chinese educators might wish to include more demonstrations and lab activities to stimulate their students, and to make science more fun.

Individual educators could probably find many additional insights through further examination of this information. You are invited to do so.

SCIENCE STUDY ATTITUDES

Grade_____ Sex_____ Date_____

Please respond to each of the following statements by circling the number which best describes your current feeling about that statement. There are no correct answers and you need not write your name at all.

	strongly disagree	disagree	neutral	agree	strongly agree
1. Science study is very easy for me	1	2	3	4	5
2. My science teacher's instructions are interesting and exciting	1	2	3	4	5
3. Our school encourages us to study science well	1	2	3	4	5
4. I study science because most of my friends study it well	1	2	3	4	5
5. I take science courses because they are required in our school	1	2	3	4	5
6. My parents (or guardians) want me to study science well	1	2	3	4	5
7. Scientists' discoveries and achievements encourage me to study science well	1	2	3	4	5
8. My brother or sister influence my study of science	1	2	3	4	5
9. My friends encourage me to study science	1	2	3	4	5
10. I dislike science because mathematics in science is very difficult	1	2	3	4	5
11. I dislike science because there is too much memorization	1	2	3	4	5
12. I dislike science because my grades in science are poor	1	2	3	4	5
13. I think that science knowledge will be very useful for a future job	1	2	3	4	5
14. I study science because it is the foundation for higher education	1	2	3	4	5
15. I feel honored that I have much knowledge of modern science	1	2	3	4	5
16. Science knowledge and techniques are useful for my daily life	1	2	3	4	5
17. I enjoy science classes and plan to take more science courses	1	2	3	4	5
18. I like doing science experiments in the classes	1	2	3	4	5
19. Science courses are among my favorite classes	1	2	3	4	5
20. I like studying animals and plants	1	2	3	4	5
21. I am interested in the science of physics	1	2	3	4	5
22. I am interested in the science of chemistry	1	2	3	4	5
23. I like reading science books and news	1	2	3	4	5
24. I like trials, discoveries, and creations in science	1	2	3	4	5
25. I would like to pursue a science-related career in the future	1	2	3	4	5

(Thank you)